



Reducing Bird Fatalities in the Altamont Pass Wind Resource Area



Principal Investigators

Carl G. Thelander
Shawn Smallwood, Ph.D.

BioRESOURCE CONSULTANTS

P.O. Box 1539

Ojai, CA 93024

805-646-3932

www.BioRC.com

CT@BioRC.com

Puma@Davis.com



“Golden Eagle nesting densities are greater in the Altamont region than anywhere else in North America.”

W. Grainger Hunt, Ph.D., University of California, Santa Cruz



Phase 1 Study Objectives: This research effort involving 1,536 wind turbines was aimed at **better understanding bird mortality** at the world's largest wind farm - the Altamont Pass Wind Resource Area (APWRA) - in central California.

We also studied bird behaviors, raptor prey availability, wind turbine/tower design, inter-turbine distribution, landscape attributes, and range management practices in our effort to explain the variation in bird mortality in the APWRA.

Our primary research objectives were to: (1) quantify bird use, including characterizing and quantifying perching and flying behaviors exhibited by individual birds around wind turbines; (2) evaluate flying behaviors and the environmental and topographic conditions associated with flight behaviors; and (3) identify possible relationships between bird behaviors and bird fatalities, wind tower design and operations, landscape attributes, and prey availability.

Phase 2 Study Objectives: In Phase 2 the research attempted to:

- (1) quantify bird use, including characterizing and quantifying perching and flying behaviors exhibited by individual birds around wind turbines;
- (2) evaluate the flying behaviors and the environmental and topographic conditions associated with flight behaviors;
- (3) identify possible relationships between bird fatalities and bird behaviors, wind tower design and operations, landscape attributes, and prey availability; and
- (4) **develop predictive, empirical models** that identify areas or conditions that are associated with high vulnerability.

- Studied 1,526 turbines in Phase 1 (avg. 53 day intervals) and 2,548 turbines in Phase 2 (avg. 90 day intervals), representing 75% of the APWRA turbines.
- Conducted ~33,000 turbine searches for dead birds.
- Found 1,189 carcasses near turbines; most fatalities (1,162) were attributed to turbines.
- Over 40 bird species represented among the fatalities: research mainly focused on raptors (4 particular species of interest).
- Mapped rodent burrow distributions at 571 turbines.
- Recorded 3,884 minutes of raptor activity as part of our behavior studies.

Mortality versus Fatalities

- Each dead bird is one fatality; usually expressed as a frequency.
- Mortality estimates rely on fatalities to calculate a rate function (#killed/MW/year)
- Mortality estimates are usually based on *sampling* a subset of turbines for kills then using the frequency to calculate a rate of kill, or mortality (example: #kills/MW/year)
- The mortality calculation typically includes several correction factors (i.e. scavenging, detection, >50 meter finds) . Values used as factors vary. Which factors to apply varies.
- Only fatalities that meet specific criteria are used to calculate mortality estimates.

Phase 1: NREL funded *mortality* and *flight behavior* studies in anticipation of repowering by industry.

1998-2001 Limited access provided to turbines.

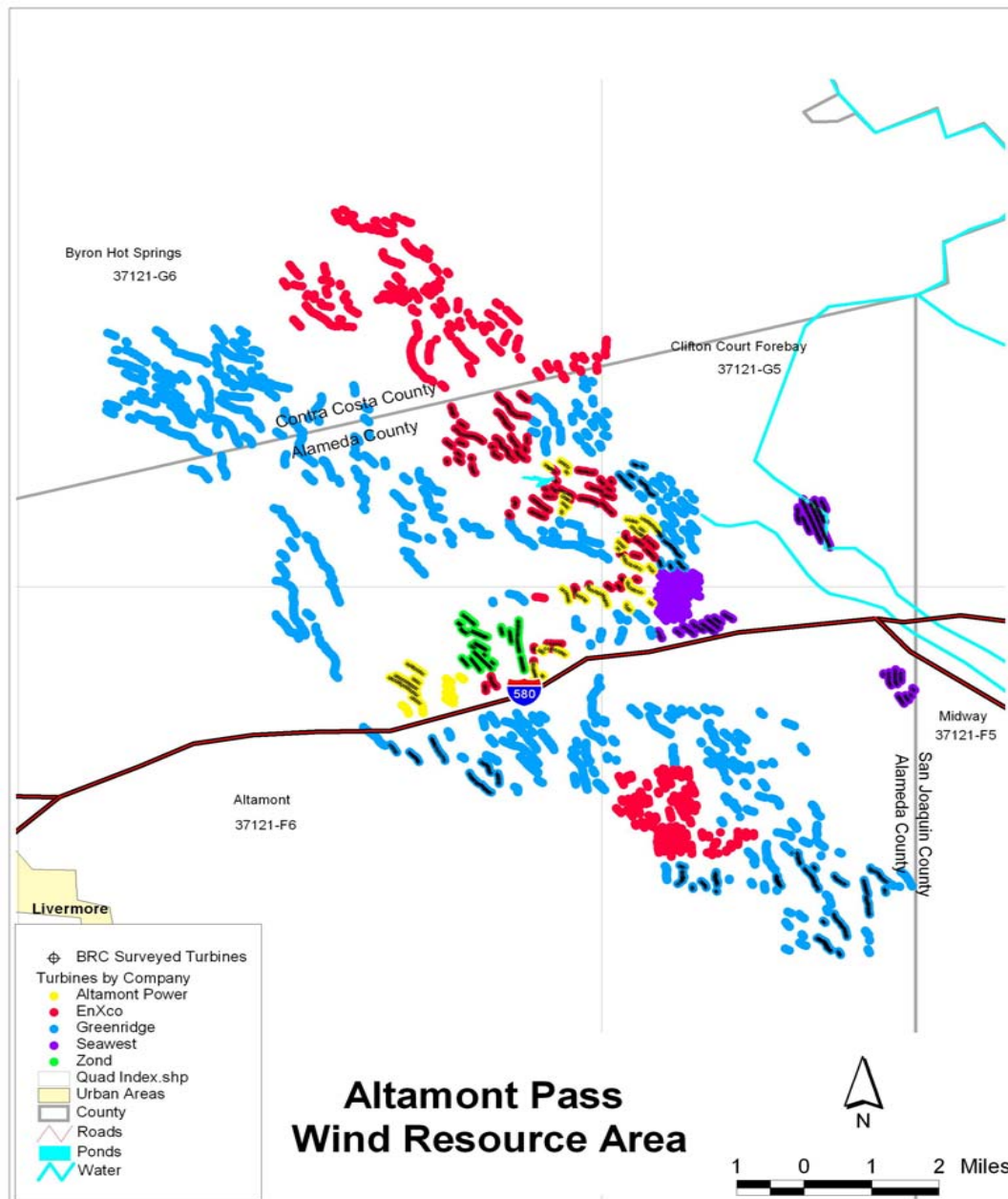
Report focused on mortality.

Phase 2: CEC funded *fatality association* (i.e., model development) studies also aimed at assisting repowering effort.

2001-2004 Full access to turbines provided eventually.

Report focused on association models.

Repowering was never undertaken during the life of the research.

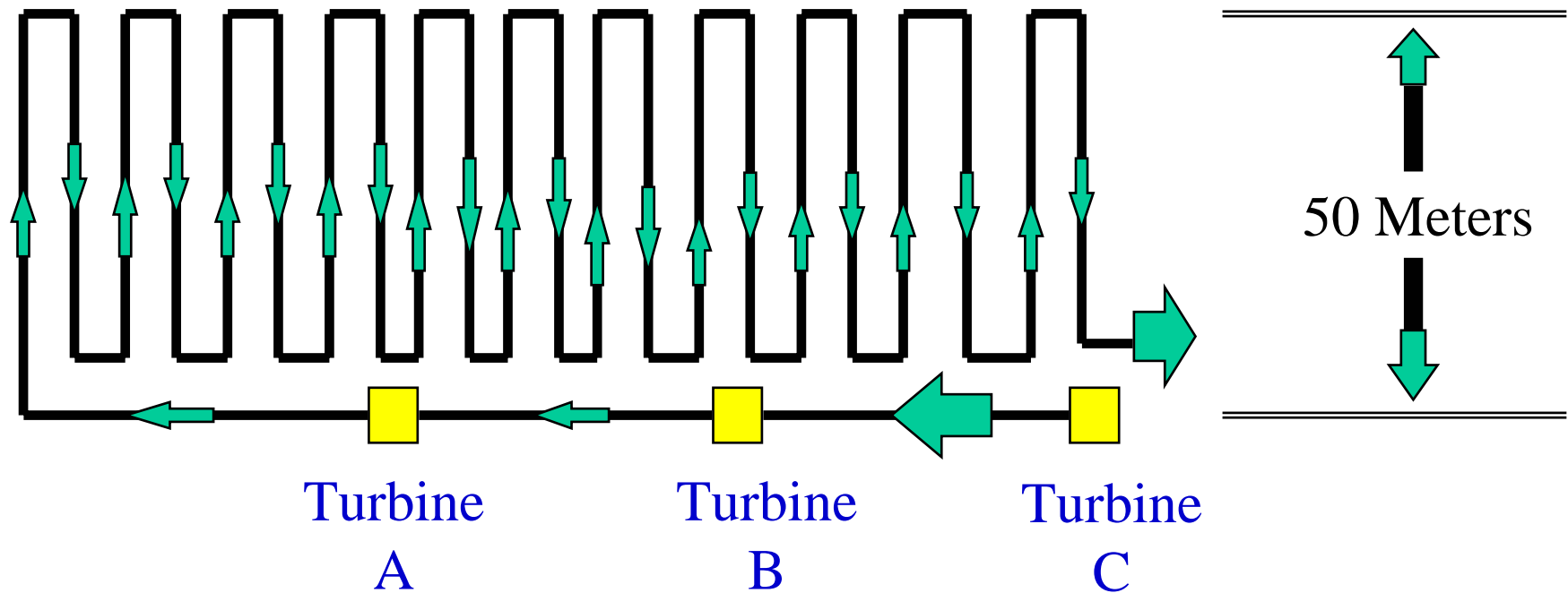


Until October 2002 (Phase 1) only about 28% of the APWRA turbines had been surveyed.

During Phase 2 we eventually gained access to all turbines, but the result was a differential sampling effort.

Fatality Search Methodology

One Observer Per Side



Red-tailed Hawks are the most frequently killed raptor in the Altamont Pass WRA.



Raptor fatalities used to estimate mortality (from Table 3-1: Type A)

Red-tailed Hawk	213
Burrowing Owl	70
American Kestrel	59
Golden Eagle	54
Barn Owl	50
Great Horned Owl	18
Common Raven	12
Turkey Vulture	6
Northern Harrier	3
Prairie Falcon	3



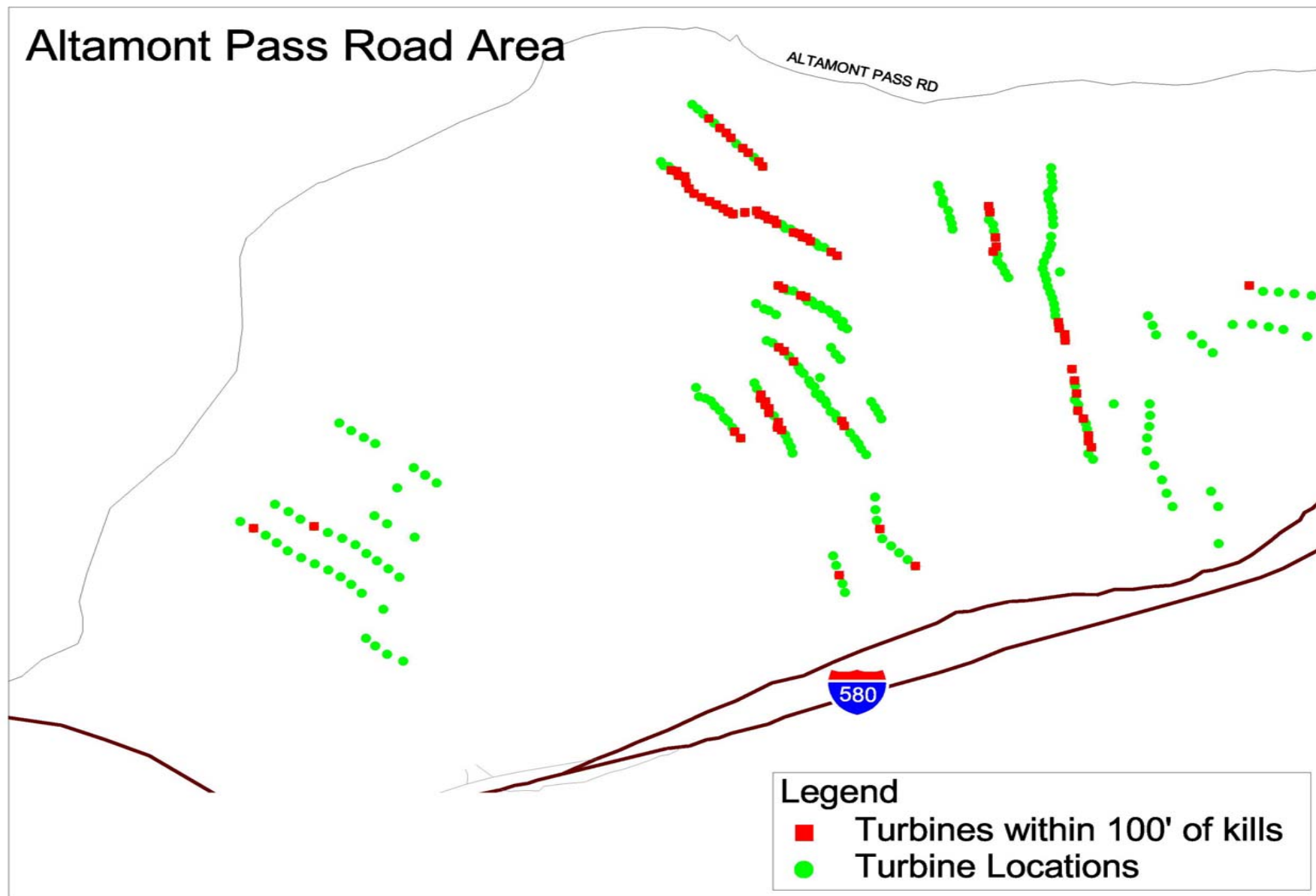
Selected non-raptor fatalities (Table 3-1; Type A)

Rock Dove ('Pigeons')	196
Western Meadowlark	96
European Starling	67
Mallard	35
Horned Lark	23
Laridae sp. (gulls)	29
Hirundinidae sp. (swallows)	6
Loggerhead Shrike	5



... Red-winged blackbird

High Risk Towers/Strings



Index elements...

Turbine Placement (for *Turbine* level of analysis)

Slope aspect
 Elevation
 Slope steepness
 Proximity to derelict turbines
 Number of other towers within 300 m
 Declivity winds (yes, no)
 Position in string (end, 2nd to end, middle, next to gap)
 Relief (canyon, ridge top, ridge line, slope, swale, plateau, peak)

Turbine String (for *String* level of analysis)

Windwall (yes, no)
 Windswept area
 Number of turbines in string
 Relief (% turbines in canyon, ridge top, ridge line, slope, swale, plateau)
 Declivity winds (yes, no)
 Slope aspect
 Elevation (average)
 Steepness (average)
 Non-op turbines as percent of string

Range Management

Level of rodent control (pounds/acre applied)
 Level of grazing (vegetation height in Sept)
 Degree of gopher clustering near towers
 Rodent activity level

Behavior

Relative abundance
 Height distribution of flights
 Distribution of time flying or perching
 Use of towers as perches
 Proximity of flights to turbines

Turbine/Tower Design

Tower type
 Power generated
 Rotor diameter
 Rotor speed
 Rotor height
 Perching opportunities
 Facing toward or away from wind
 Color scheme

Laydown Area

Platform overhang
 Rock piles
 Vertical/lateral edge
 Use by cattle
 Cottontail abundance
 Lizard abundance

Key Response Point 1:

The report has been reviewed extensively, including by scientists, the Altamont wind operators and their consultants.

We request that judgment be withheld until a peer review process that satisfies the CEC is completed, or until results are published by BRC in professional, peer reviewed journals.

Key Response Point 2:

We recommend applying the bird kill reduction techniques offered using experimental approaches initially and within the framework of an adaptive management program.

Positive results will reveal the degree of reduction attributable to each technique.

Large sample sizes and intense bird kill monitoring will be needed if statistically defensible differences are to be properly detected/documentated.

Key Response Point 3:

Individual mortality estimates differ in their certainty between Phase 1 and Phase 2 because of differential sampling effort.

We combined these data and calculated a weighted average, which met our study needs.

We reported estimated mortality per species as a range of values, only for each species found more than once. Estimates for species with smaller samples sizes are less reliable than others.

Our focus was on large birds, mainly raptors. Reliability is high for these species' estimates.

Key Response Point 4:

Standard correction factors (per NWCC, APLIC) were applied to mortality estimates (detection, scavenging, >50 meter finds).

Other correction factors not applied. Our estimates and choices to apply factors were conservative.

Additional justifiable correction factors would have increased the maximum estimates for each species, but would not appreciably change the mean values.

‘All bird’, ‘All raptor’, and other pooled mortality estimates are complex equations, but each is thoroughly documented and defensible.

Unadjusted versus adjusted annual mortality estimates.

	Raw	SD	SD+SVG
Golden Eagle	59.5	75.6	116.5
Red-tailed Hawk	154.1	208.9	300.4
American Kestrel	59.2	73.3	333.1
Burrowing Owl	72.1	98.8	380.2
All Raptors	656.4	881.4	1300.3
All Birds	994.8	1766.5	4721.3

SD = with searcher detection factor

SD + SVG = with searcher detection and scavenging

Key Response Point 5:

In Phase 1, mortality estimates were a priority. They are not used to develop association models.

In Phase 2, association models relied more on bird frequency and the collection of other data that characterized the setting and location of each fatality.

In Phase 2, our study design placed a higher priority on finding fatalities representative of a broader physiographic and topographic sample of the APWRA, to aid our models, than on meeting the assumptions for calculating robust and highly reliable mortality estimates.

Key Response Point 6:

Our results focused mainly on four raptor species.

They are highly visible; their carcasses are relatively easy to find, they remain detectable for long periods (often > 120 days or more), and they rarely disappear entirely due to scavenging.

Red-tailed hawks were the most commonly found raptor at turbines. Our data base is substantial for our four priority species. The results for these species are highly reliable.

Our research goals for these key species were met.

Key Response Point 7:

Feather spots are a standard metric used to document bird fatalities caused by wind turbines. Feathers are often all that is left of small birds hit by turbine blades.

For example, two studies reported using feather spots to assign 42% and 55%, respectively, of all fatalities as turbine-caused.

We relied on feather spots for only 22% of ‘cause of death’ determinations being related to wind turbines.

Typically these were small bird species, not our core species.

Key Response Point 8:

Review comments tended to focus on marginal data sets, not on core issues that would affect the overall outcome of any statistical treatments, or our results/recommendations.

We stand by our results and will publish them in professional journals soon. One manuscript is already submitted for publication.

Key Response Point 9:

Extensive collaboration has existed between the authors and the APWRA owners and their consultants.

Study design and methods were developed with consultation from authors of NWCC guidelines.

The report has been reviewed extensively, including by scientists, industry, and their consultants.

We have reported on our progress openly through reports and through presentations, including to AWEA, and workshops organized by the NWCC.

